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Space systems — Fluid characteristics, sampling and test methods —

Part 7:
Hydrazine propellant

Systèmes spatiaux — Caractéristiques des fluides, échantillonnage et méthodes d'essai —
Partie 7: Hydrazine (carburant)

ICS 49.140

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Foreword

ISO (the International Organization for Standardization) is a worldwide federation of national standards bodies (ISO member bodies). The work of preparing International Standards is normally carried out through ISO technical committees. Each member body interested in a subject for which a technical committee has been established has the right to be represented on that committee. International organizations, governmental and non-governmental, in liaison with ISO, also take part in the work. ISO collaborates closely with the International Electrotechnical Commission (IEC) on all matters of electrotechnical standardization.

International Standards are drafted in accordance with the rules given in the ISO/IEC Directives, Part 3.

The main task of technical committees is to prepare International Standards. Draft International Standards adopted by the technical committees are circulated to the member bodies for voting. Publication as an International Standard requires approval by at least 75 % of the member bodies casting a vote.

Attention is drawn to the possibility that some of the elements of this part of ISO 15859 may be the subject of patent rights. ISO shall not be held responsible for identifying any or all such patent rights.

ISO 15859-7 was prepared by Technical Committee ISO/TC 20, *Aircraft and space vehicles*, Subcommittee SC 14, *Space systems and operations*.

ISO 15859 consists of the following parts, under the general title *Space systems — Fluid characteristics, sampling, and test methods*:

— *Part 1: Oxygen*

— *Part 2: Hydrogen*

— *Part 3: Nitrogen*

— *Part 4: Helium*

— *Part 5: Nitrogen tetroxide propellants*

— *Part 6: Monomethylhydrazine propellant*

— *Part 7: Hydrazine propellant*

— *Part 8: Kerosine propellant*

— *Part 9: Argon*

— *Part 10: Water*

— *Part 11: Ammonia*

— *Part 12: Carbon dioxide*

— *Part 13: Breathing air*

Introduction

This International Standard specifies limits for the composition of anhydrous hydrazine and establishes the fluid sampling and test methods for anhydrous hydrazine propellant intended for use as a fuel in propellant systems of space systems. The purpose of this International Standard is to establish uniform requirements for sampling and test methods for anhydrous hydrazine propellant used in the servicing of launch vehicles, spacecraft, and ground support equipment.

Fluid operations at a spaceport or launch site may involve a number of operators and supplier/customer interfaces, from the fluid production plant to the delivery to the launch vehicle or spacecraft. The fluid composition limits specified in this International Standard are intended to define the purity and impurity limits of the fluid for loading into the launch vehicle or spacecraft. The fluid sampling and test methods included in this International Standard are intended to be applied by any operator. The fluid sampling and test methods presented in this International Standard are acceptable methods for verification of the fluid composition limits.

Space systems — Fluid characteristics, sampling and test methods —

Part 7:
Hydrazine propellant

1 Scope

This part of ISO 15859 specifies limits for the composition and physical properties of anhydrous hydrazine (N_2H_4) and defines the fluid sampling and applicable test methods for verification of anhydrous hydrazine composition. This International Standard establishes acceptable composition, test, and sampling requirements. This part of ISO 15859 is applicable to anhydrous hydrazine propellant of the following grades, intended for use as a fuel in propellant systems of space systems.

CAUTION — Hydrazine, in the liquid or vapor form, is toxic and volatile. Care should be taken in the handling and storage of hydrazine to prevent contact with the human body and with materials that are not compatible with hydrazine.

— Standard: normal production and quality control (suitable for most uses);

— Monopropellant: normal product with strict control of specified impurities (to be specified only for monopropellant catalytic engines where extended life of the catalyst is desired);

— High purity: special production with strict control of specified impurities.

This part of ISO 15859 is applicable to propellant used in both flight hardware and ground facilities, systems, and equipment. It is applicable to influents only to the extent specified herein. Hydrazine may be of the liquid type.

This part of ISO 15859 is applicable to any sampling operation required to ensure that, when the fluid enters the launch vehicle or spacecraft, the fluid composition complies with the limits provided hereafter or with any technical specification agreed to for a particular use.

2 Normative references

The following normative documents contain provisions which, through reference in this text, constitute provisions of this part of ISO 15859. For dated references, subsequent amendments to, or revisions of, any of these publications do not apply. However, parties to agreements based on this part of ISO 15859 are encouraged to investigate the possibility of applying the most recent editions of the normative documents indicated below. For undated references, the latest edition of the normative document referred to applies. Members of ISO and IEC maintain registers of currently valid International Standards.

ISO 8402:1994, Quality management and quality assurance – Vocabulary.

3 Terms and definitions

For the purposes of this part of ISO 15859, the terms and definitions given in ISO 8402 and the following apply.

3.1
particulate
(standard grade) undissolved solids retained on a filter paper with a 10 μm nominal and 40 μm absolute rating

3.2
particulate
(monopropellant and high purity grades) undissolved solids retained on a filter paper with a 2 μm nominal and 10 μm absolute rating.

3.3
verification tests
analyses performed on the fluid in the container, or a sample thereof, which is representative of the supply

4 Composition

4.1 Limits

Unless otherwise provided in an applicable technical specification, the composition of hydrazine propellant delivered to the flight vehicle interface shall be in accordance with the limits given in Table 1 when tested in accordance with the applicable test methods.

Table 1 — Composition limits

Composition		Limits		
		Standard grade	Mono-propellant grade	High purity grade
Hydrazine	mass fraction, %, min.	98	98,3	99,0
Water	mass fraction, %, max.	1,5	1,2	1,0
Ammonia	mass fraction, %, max.	—	—	0,3
Particulate	mg/L, max.	10	1,0	1,0
Chloride	mass fraction, %, max.	—	0,000 5	0,000 5
Aniline	mass fraction, %, max.	—	0,50	0,003
Iron	mass fraction, %, max.	—	0,002	0,000 4
Nonvolatile residue	mass fraction, %, max.	—	0,005	0,001
Carbon dioxide	mass fraction, %, max.	—	0,003	0,003
Other volatile carbonaceous components[a]	mass fraction, %, max.	—	0,02	0,005

[a] Total as monomethylhydrazine (MMH), unsymmetrical dimethylhydrazine (UDMH) and alcohol.

4.2 Qualitative properties

The propellant shall be a colourless, homogeneous liquid when examined visually by transmitted light.

4.3 Procurement

The hydrazine grades specified in Clause 1 should be procured in accordance with an applicable national standard.

5 Fluid sampling

5.1 Plan

In order to ensure that the fluid composition complies with the limits specified in this International Standard, a fluid sampling plan should be established by all the involved operators, from the production to the space vehicle interface, and approved by the final user. Such plan shall specify:

— the sampling points;

— the sampling procedures;

— the sampling frequency;

— the sample size;

— the number of samples;

— the test methods;

— the responsibilities of any involved operator.

CAUTION — Hydrazine, in the liquid or vapor form, is toxic and volatile. Care should be taken in the handling and storage of hydrazine to prevent contact with the human body and with materials that are not compatible with hydrazine.

5.2 Responsibility for sampling

Unless otherwise provided in an applicable technical specification, the hydrazine delivered to the flight vehicle interface shall be sampled and verified by the supplier responsible for providing the hydrazine to the flight vehicle. The supplier may use its own or any other resources suitable for the performance of the verification tests specified herein unless otherwise directed by the customer.

5.3 Sampling points

Unless otherwise specified, sampling shall be conducted at the fluid storage site or the flight vehicle interface.

5.4 Sampling frequency

Sampling shall be annually or in accordance with a time agreed upon by the supplier and the customer.

5.5 Sample size

The quantity in a single sample container shall be sufficient to perform the analysis for the limiting characteristics. If a single sample does not contain a sufficient quantity to perform all of the analyses for the required quality verification test, additional samples shall be taken under similar conditions.

5.6 Number of samples

The number of samples shall be in accordance with one of the following:

a) one sample per storage container;

b) any number of samples agreed upon by the supplier and the customer.

5.7 Storage container

Unless otherwise provided by the applicable sampling plan, the fluid storage container shall not be refilled after the time the sample is taken.

5.8 Liquid samples

Liquid samples shall be a typical specimen from the liquid hydrazine supply. For safety reasons, the sample container and sampling system must have a rated service pressure at least equal to the pressure in the supply container. Samples shall be obtained in accordance with one of the following:

a) by filling the sample container and storage containers at the same time, on the same manifold, and under the same conditions and with the same procedure;

b) by withdrawing a sample from the supply container through a suitable connection into the sample container. No pressure regulator shall be used between the supply and the sample containers (suitable purge and drain valves are permissible).

5.9 Rejection

When any sample of the fluid tested in accordance with Clause 6 of this International Standard fails to conform to the requirements specified herein, the fluid represented by the sample shall be rejected. Disposition of the rejected fluid shall be specified by the customer.

6 Test methods

6.1 General

The supplier will ensure, by standard practice, the quality level of hydrazine. If required, alternate test methods are described in Clause 6 of this International Standard. Other test methods not listed in this International Standard are acceptable if agreed upon between the supplier and the customer.

These tests are a single analysis or a series of analyses performed on the fluid to ensure the reliability of the storage facility to supply the required quality level. This can be verified by analysis of representative samples of the fluid from the facility at appropriate intervals as agreed upon between supplier and the customer. Tests may be performed by the supplier or by a laboratory agreed upon between the supplier and the customer.

The analytical requirements for the tests shall include the determination of all limiting characteristics of hydrazine.

6.2 Parameters of analysis

The parameters for analytical techniques contained in this section are:

a) purity and impurity contents shall be expressed as a percentage (%) by weight unless otherwise specified;

b) calibration standards containing the applicable liquid components may be required to calibrate the analytical instruments used to determine the limiting characteristic levels of fluid;

c) if required by the customer, the accuracy of the measuring equipment used in preparing these standards shall be traceable to an established institute for standards;

d) analytical equipment shall be operated in accordance with the manufacturer’s instructions;

e) analytical methods not listed in this International Standard are acceptable if agreed upon between the supplier and the customer.

6.3 Hydrazine purity

The hydrazine concentration shall be determined by a gas chromatographic method. This method may be used not only for hydrazine but also for the determination of water, ammonia, aniline, and other volatile carbonaceous components. The analyzer shall be capable of separating and detecting the component with a sensitivity of 10 % of the specified maximum amount of the component. The analyzer shall be calibrated at appropriate intervals by the use of calibration standards.

6.4 Water content

The water content shall be determined by a gas chromatographic method, such as described in 6.3 of this International Standard.

6.5 Ammonia content

The ammonia content shall be determined by a gas chromatographic method, such as described in 6.3 of this International Standard.

6.6 Particulate matter content

The particulate matter content shall be determined by a gravimetric measurement method. A known volume of fuel is filtered through a preweighed test membrane filter and the increase in membrane filter weight is determined after washing and drying. The change in weight of a control membrane filter located immediately below the test membrane filter is also determined. The particulate matter contaminant is determined from the increase in weight of the test membrane filter relative to the control membrane filter.

6.7 Chloride content

The chloride content shall be determined by one of the following methods:

a) by an ion chromatographic method;

b) by a colorimetric method with mercury thiocyanate;

c) by a potentiometric method using chloride-specific electrode;

d) by a silver nitrate titration potentiometric method.

The chloride content cannot be measured directly in the liquid hydrazine sample but from a nonvolatile residue after dissolving it in an aqueous acid solution.

6.8 Aniline content

The aniline content shall be determined by one of the following methods:

a) by a gas chromatograph method such as described in 6.3 of this International Standard;

b) by an ultraviolet spectrophotometric method for the monopropellant grade hydrazine.

6.9 Iron content

The iron content shall be determined by one of the following methods:

a) by an atomic absorption method;

b) by a colorimetric method;

c) by an inductively coupled argon plasma emission spectrometric method.

The iron content cannot be measured directly in the liquid hydrazine sample but can be measured either from a solution of hydrazine in water or a nonvolatile residue after dissolving it in an aqueous acid solution.

6.10 Nonvolatile residue (NVR) content

The nonvolatile residue content shall be determined by a gravimetric measurement method in accordance with the following procedure: a measured sample is gradually evaporated using a suitable heat source in a fume hood. The difference in weight before and after evaporation is calculated as the nonvolatile residue.

6.11 Carbon dioxide content

The sample shall be injected into a strong acid in order to absorb the hydrazine and ammonia components and liberate carbon dioxide. The carbon dioxide content shall then be determined by one of the following procedures:

a) by a gas chromatographic method. The technique utilized shall be specific for the separation and analysis of carbon dioxide;

b) by an infrared analysis method;

c) by a specific CO_2 coloumetric method.

6.12 Other volatile carbonaceous component content

The content of other volatile carbonaceous components shall be determined by a gas chromatographic method such as described in 6.3 of this International Standard. The other components to be measured are usually monomethylhydrazine (MMH), unsymmetrical dimethylhydrazine (UDMH), and alcohols (methyl and isopropylalcohols). The analyzer shall be capable of separating and detecting these components.

Annex A
(informative)

Gaseous chromatography (GC) applications

Gaseous chromatography (GC) should be used as the reference or preferred method to analyze some hydrazine impurities, for example, water and ammonia contents, aniline content (for the high purity grade), other volatile carbonaceous material, and carbon dioxide contents for hydrazine purity control.

Table A.1 summarizes the applications of these methods for hydrazine. "—" indicates that the method is not used for the characteristic.

Table A.1 — Application of GC

Characteristic	Application			
	GC with TCD detector	**GC with FID detector**	**GC with FID detector**	**GC with TCD detector and cryogenic trape**
Hydrazine purity	GC with TCD detector, on Tenax GC or PEG 1540 column (or equivalent)	—	—	—
Water	GC with TCD detector, on Tenax GC or PEG 1540 column (or equivalent)	—	—	—
Ammonia	GC with TCD detector, on Tenax GC or PEG 1540 column (or equivalent)	—	—	—
Aniline (high purity)	—	GC with FID detector, on Tenax GC or Apiezon L/AT200 or wide bore (carbowax 20M) capillary column (or equivalent)	—	—
Other volatile carbonaceous components	—	—	GC with FID detector, on Tenax GC or PEG 1540 or 400 column (or equivalent)	—
Carbon dioxide	—	—	—	GC with TCD detector and cryogenic trape, on charcoal or Porapack column (or equivalent)